

SELF-BALANCING BOARD WITH PRIMARY WHEEL AND DISTAL AUXILIARY WHEEL

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of, and claims the benefit of U.S. patent application Ser. No. 16/115,534 filed on Aug. 28, 2018, which is a continuation of and claims the benefit of U.S. patent application Ser. No. 15/894,112, filed on Feb. 12, 2018), which is a continuation of and claims the benefit of PCT/CN2016/105834, filed on Nov. 5, 2016, which is a continuation-in-part of, and claims the benefit of PCT Patent Application No. PCT/IB2015/058821, filed on Nov. 15, 2015, the contents of which are incorporated herein by reference in their entirety.

FIELD OF THE INVENTION

[0002] This invention relates to transportation vehicles for individuals, particularly a self-balancing board such as a device known as a one-wheeled skateboard which incorporates a motorized primary wheel.

BACKGROUND OF THE INVENTION

[0003] Self-balancing vehicles for transportation of individuals are known in the art. As described in U.S. Pat. No. 6,302,230B1 and AT299826 (Kamen), such vehicles are typically equipped with two coaxial, individually driven wheels, spaced apart and with a platform between, onto which a rider of the vehicle may stand facing in an intended forward direction of motion. Gyroscopic and accelerometer sensors detect changes in orientation of the platform and feed information to a motor control system. The motor system is programmed to maintain platform orientation horizontal within a certain range by rotating the wheels in any direction, having the effect of aligning the centers-of-gravity of the vehicle and the rider whilst the vehicle has a constant velocity. On some types, there is an upright handlebar connected to the platform, giving the rider ability to further control the vehicle by leaning sideways, whereby the wheels will rotate at different speeds and/or direction, causing the vehicle to turn.

[0004] Another variant of the above-described self-balancing vehicle is taught by U.S. Pat. No. 8,738,278B2 (Chen) in which a vehicle has two spaced, individually powered wheels that are controlled by a motor control system, with a platform between which is split laterally in two halves. Each half of the platform is associated with one wheel and its motor control system, and corresponds to the position of left and right feet of a rider of the vehicle. The two halves are pivotally coupled to one another, whereby the rider can control the relative speed and rotation direction of the two wheels independently using their feet to tilt the two platform sections. One benefit of this type of self-balancing vehicle is the lack of need for an upright handlebar, making the unit smaller and maneuverable without using the hands.

[0005] A third type of self-balancing vehicle disclosed by US20110220427A1 (Chen) a single large wheel and footrests on either side of the wheel. Friction pads extending upwards from each footrest are designed to give the rider more stability and comfort by providing support to the inside of the rider's calves.

[0006] A fourth type of self-balancing vehicle has a single wheel and a platform shaped like that of a skateboard. The

rider places one foot on each side of a centrally positioned single wheel, and the intended direction of travel is sideways relative to the orientation of the rider. U.S. Pat. No. 9,101,817 Doerksen describes such a vehicle. There are also developments described in the art towards the safety aspects of this type of vehicle. Although the nature of an electric DC motor is that it can also be used in reverse as a brake, whereby the motor is used as a dynamo and electric energy is generated, more braking power may be desired. CN103191558A (Chu) describes a similar self-balancing board with a separate brake mechanism acting on the single central wheel, thereby increasing the braking power. U.S. Pat. No. 7,811,217 (Odien) discloses a self-balancing board with dual centrally positioned wheels, each having a brake associated with it. U.S. Pat. No. 7,424,927B2 (Hiramatsu) also describes a self-balancing board with a single central wheel, having auxiliary wheels in front and back. The auxiliary wheels are used to sense board angle via contact with a surface, each auxiliary wheel having sensors to determine the time the board has spent in a certain max tilt angle and feed information to the motor controller in order to initiate a controlled deceleration of the motor, and thus the central wheel.

SUMMARY

[0007] According to an aspect, there is provided a self-balancing board, including a primary wheel assembly that includes a primary wheel and a motor driving the primary wheel. The board further includes a platform secured to the primary wheel assembly and having a foot deck, at least one sensor sensing the orientation of the platform, a controller receiving data from the at least one sensor and controlling the motor in response to the received data, a first auxiliary wheel assembly coupled to the platform distal the primary wheel assembly, the first auxiliary wheel assembly being elevated from contacting a flat surface upon which the primary wheel rests when the foot deck is parallel to the flat surface and being engaged with the flat surface upon which the primary wheel rests when the foot deck is tilted by a selected angle, so as to cooperate with the primary wheel to support the self-balancing board on the flat surface without triggering braking by the controller on the primary wheel, and a first brake element that is manually movable relative to the first auxiliary wheel assembly to engage the first auxiliary wheel assembly to provide resistance to rotation of the first auxiliary wheel assembly.

[0008] The self-balancing board can further comprise a first brake pedal being biased to a disengaged position and being movable to an engaged position in which the first brake element contacts the first auxiliary wheel assembly.

[0009] The first brake pedal can be coupled to the platform via a mechanical hinge.

[0010] The first brake pedal can be coupled to the platform via a living hinge.

[0011] The first brake element can comprise a first brake pad, the first brake element being linearly biased away from the first auxiliary wheel assembly, and wherein the first brake element can be manually moved towards the first auxiliary wheel assembly to cause the first brake pad to come into contact with the first auxiliary wheel assembly.

[0012] The first auxiliary wheel assembly can be biased away from the platform, and wherein pressure applied to the platform proximal to the first auxiliary wheel assembly